SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

Draft Staff Report

PROPOSED AMENDED RULE 1149 – STORAGE TANK AND PIPELINE CLEANING AND DEGASSING

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EXECUTIVE SUMMARY

Rule 1149 – Storage Tank Cleaning and Degassing was originally adopted by the South Coast Air Quality Management District (AQMD) on December 4, 1987 and subsequently amended on April 1, 1988 and July 14, 1995.

Rule 1149 applies to VOC emissions from cleaning and degassing operations in large aboveground petroleum storage tanks at petroleum refineries and terminals and small underground gasoline storage tanks. The current regulation requires vapors contained in storage tanks to be vented to a control device for a pre-determined length of time or to be displaced by a liquid into a control device.

The proposed rule amendments will instead require a vapor concentration of 5,000 ppmv, measured as methane, to be met before allowing the vapors to be vented to atmosphere. This proposed standard will better capture emissions from sludge and product residual remaining in the tanks. Liquid balancing, or any other technology that achieves the proposed standard will be allowed.

The proposed rule amendments will also expand its applicability to small above ground gasoline storage tanks, pipelines and large storage tanks previously exempted because of lower vapor pressure products. Furthermore, the proposed amendments will streamline the notification process and clarify requirements for vacuum trucks and containers used for storing liquid and sludge removed during the cleaning process.

If approved, the proposed rule amendments would fully implement control measure FUG-04 in the 2007 Air Quality Management Plan.

As proposed, the rule would reduce VOC emissions by between 1.27 and 1.97 tons per day at an estimated annual cost between $6.1 million dollars. The overall cost per ton of VOC reduced by the proposed amendment is estimated to be $13,159.

Many degassing operations routinely achieve in practice the proposed requirements set forth in the proposed rule. California Code of Regulations, Title 8 - General Industry Safety Orders has strict restrictions for entry into confined spaces with hazardous atmospheres such as petroleum storage tanks. In order to avoid the restrictions, many facilities vent the vapors contained in the storage tanks into a control device until the tank interior is no longer considered a hazardous atmosphere and the proposed rule requirements would be met. Additionally, concern for nearby schools and residences as well as the potential for Rule 402 – Nuisance violations keeps facilities from discharging odorous VOC emissions.

A quantification protocol is included in the proposed amendment to quantify Greenhouse gas reductions. The provision in Proposed Amended Rule (PAR) 1149 is voluntary and limited to the control of methane emissions from the degassing of natural gas pipelines, which is currently exempt from the requirements of the rule. Efforts to limit methane emissions from natural gas pipeline repair and maintenance activities will allow companies to reduce Greenhouse gas emissions.

REGULATORY BACKGROUND

In 1987, Rule 1149 – Storage Tank Cleaning and Degassing was adopted to reduce VOC emissions from degassing operations of stationary storage tanks. The Standard Industrial Classification codes for applicable facilities include crude petroleum and natural gas (SIC code 1311), paints, varnishes, lacquers, enamels, and allied products (SIC code 2851), cyclic organic

crudes and intermediates, and organic dyes and pigments (SIC Code 2865), industrial organic chemicals, not elsewhere classified (SIC code 2869), petroleum refining (SIC code 2911), special warehousing and storage, not elsewhere classified (SIC code 4226), crude petroleum pipelines (SIC code 4612), refined petroleum pipelines (SIC code 4613), chemical and allied products, not elsewhere classified (SIC code 5169), petroleum bulk stations and terminals (SIC code 5171), and automotive dealers and gasoline service stations (SIC code 5541).

At the time of adoption, staff estimated that 800 floating roof tanks, 213 fixed roof tanks and 33,600 underground storage tanks (UST) located at petroleum refineries and terminals, chemical plants and gasoline stations would be subject to the rule. Based on each tank being degassed once every ten years, an estimated 0.4 tons per day were expected to be controlled from floating and fixed roof tanks and another 0.3 tons per day were to be controlled from USTs.

The premise of the rule has been a differential equation describing the change in concentration:

$$dC/dt + QC/V = 0$$

where dC/dt is the change in concentration in the tank over time, Q is the flow rate, C is the final concentration and V is the volume.

The solution to the equation:

$$C = C_o\, e^{-(Qt/V)}$$

when the final concentration is 10 percent of the initial concentration, or $C = 0.1C_o$, gives:

$$0.1C_o = C_o\, e^{-(Qt/V)}$$

$$\text{or } 0.1 = e^{-(Qt/V)}$$

Thus theoretically, to get a 90 percent reduction in emissions, then $t = 2.3V/Q$. Or in other words, if a tank were to be degassed to a control device for a period of time equal to 2.3 volume turnovers, 90 percent of the emissions would be controlled. The use of the equation makes a key assumption which is that the storage tank has no product or sludge remaining in the tank when the degassing begins.

In 1995 the rule was amended to remove ambiguities in rule language relating to business and regulatory practices. Specifically, the clarifications included alteration of notification procedures and confirming that USTs to be degassed must be controlled and done in a timely period even if it is removed from the ground. It also intended to extend the application of the rule to storage tanks that were undergoing product changes by adding the term "cleaning" to the applicability of the rule.

The staff report in 1995 also noted that the number of USTs degassed was significantly lower then estimated in 1987. Despite only 30 percent of the original estimated USTs being degassed annually, the report concludes that the corresponding total emission reductions from the rule would not change significantly. This was explained by demonstrating that more than twice the emissions predicted in 1987 were being controlled by venting emissions from product and sludge removal, rinsing and degassing instead of degassing alone. While only applied to USTs, this approach is noteworthy because it deviates away from the theoretical calculations that the original emission inventory was derived from. A similar approach will be used in this report to determine the emission inventory and potential emission reductions.

AQMD Rules 463 – Storage of Organic Liquids and Rule 1178 - Further Reductions of VOC Emissions from Storage Tanks at Petroleum Facilities are closely related to this regulation. In

particular, Rule 463 specifies emptying and refilling procedures that occur just before and after degassing operations. Additionally, Rule 463 (d)(2) requires the roof to float on liquid except when the tank is being completely emptied for cleaning or repair. While there is no definition for cleaning in Rule 463, it is current AQMD policy to apply the definition of cleaning in Rule 1149 for interpretation purposes. Under Rule 1149 "cleaning" is defined as the process of washing or rinsing a stationary tank, reservoir, or other container or removing vapor, sludge, or rinsing liquid from a stationary tank, reservoir or other container. Thus the roof must float on liquid unless the tank is cleaned by completely draining the liquid and removing the VOC vapors. For example, while a tank was being drained of product, Rule 463 would apply and require the draining to be continuous. Once draining was complete and the roof landed, the VOC vapors would be removed per the requirements of Rule 1149. Once product was reintroduced into the tank, Rule 463 would once again apply.

While there are no vapor concentration limits directly associated with emptying or refilling, Rule 463 does have a vapor leak limit of 1,000 ppmv, measured as methane. Rule 1178 applies to larger storage tanks at petroleum facilities and establishes additional control requirements and specifications to those included in Rule 463. Rule 1178 applies to tanks with a True Vapor Pressure (TVP) of 5 mm Hg (0.1 psi).

The Office of Pipeline Safety is the primary federal agency regulating pipelines. There are provisions for maintaining pipelines and reporting and repairing leaks, but no provisions for controlling vapors from leaks or degassing operations. In California, the Office of the State Fire Marshall, Pipeline Safety Division regulates the safety of hazardous liquid transportation pipelines. The office inspects, tests and investigates to ensure compliance with state and federal pipeline safety laws. Like the federal government, the state has provisions for maintaining pipelines and reporting and repairing leaks, but no provisions for controlling vapors from leaks or degassing operations.

OPERATIONAL BACKGROUND

Vapors are created whenever there is a space between the liquid level and the roof of a storage tank. The more volatile (higher vapor pressure) the liquid, the more vapors are present. Large tanks with liquids like crude oil or gasoline can generate thousands of pounds of VOC vapors. These vapors will be emitted if the tank is opened to atmosphere for maintenance, repairs or removal. Vapors can also be emitted while the roof of a floating roof tank is allowed to rest on its support legs during a product change. All these types of operations are subject to the provisions of Rule 1149. The vapors will also be emitted when the tank is refilled and the vapor space is eliminated. Emissions generated from tank filling operations are covered under Rules 463 - Organic Liquid Storage and 1178 – Further Reductions of VOC Emissions from Storage Tanks at Petroleum Facilities.

Facilities limit emissions from repairs, maintenance activities, product changes and during refilling by controlling degassing operations. A product change occurs when a tank is used to temporarily store a product such as crude oil or gasoline. When the product is purchased, the entire tank is pumped to the purchaser. That leaves the tank empty, but filled with vapors and the roof resting upon the support legs. The tank seals may lose effectiveness while the roof rests upon the support legs leading to fugitive emissions. Some tanks can maintain the tanks in a "vapor tight" condition with minimal leakage even while the tank rests upon its legs. However, the vapors remain and must be controlled when the tank is filled and the vapors are displaced.

The degassing process consists of several procedures intended to leave the tank free of product, sludge and vapors. The bulk of the product in the tank, if any, is pumped into another tank. A vacuum truck then sucks out the residual product. At this point the tank is empty of liquid but may contain a relatively small amount of residual liquid, some sludge and is filled with vapors. Depending on the amount of sludge, the tank may be cleaned and rinsed before degassing (purging the gas) begins. Purging the gas is generally done by sucking the vapors out of the tank. Because of the provisions in Rule 1149, the vapors purged are vented to a control device or vapor recovery system. These controls devices are typically portable engines or thermal oxidizers that combust the vapors as fuel. Because the vapor concentration may fluctuate substantially during the process, propane is used as a supplemental fuel to ensure that enough fuel is available to maintain combustion at all times.

Other techniques used to control vapors from storage tanks include liquid balancing and water or chemical washing or rinsing. Liquid balancing consists of draining the tank until just prior to the floating roof resting on its support legs. The tank is then filled with a low vapor pressure liquid, allowing the chemicals to mix, and repeating until the desired vapor pressure of the liquid blend is reached. Because there is no vapor space created during the mixing process, no vapors are created. When the tank is finally completely drained, only vapors from the low vapor pressure liquid created remain in the storage tank.

Water or chemical washing or rinsing cleans the tank of product and residual sludge thus diminishing the amount of VOC vapor concentration in the tank. The storage tank remains closed or air tight during the cleaning process. Water or a chemical is added to the tanks, sometimes with a high pressure jet. The sludge created is pumped out and, at a minimum, further emissions from sludge and product residual will be minimized. Once the tank has been degassed, the tank will be opened to ventilate the remaining vapors. This ventilation can be done by opening a vent and pulling fresh air into the tank or using a blower to force the vapors out of the tank. There may be a final cleaning and rinsing step to remove any last remnants of sludge.

Some facilities control fugitive emissions from vacuum trucks by routing the exhaust from the truck back into the tank being degassed or to a carbon adsorber. Vapors may also be minimized by utilizing positive displacement, submersible or diaphragm pumps. While these pumps may not transfer the liquid and sludge as quickly as a vacuum truck, they minimize the agitation of the liquid and sludge which leads to increased vapors.

If the tank is taken out of service for maintenance, repair or removal, California Code of Regulations Title 8 Section 5157 prohibits entry into a hazardous atmosphere which includes flammable gas, vapor or mist in excess of 10 percent of its lower explosive limit (LEL). A significant number of tanks degassed continue venting vapors to the control device until the 10 percent LEL is met. It should be pointed out that as currently written, a company can comply with Rule 1149 by purging the vapors to a control device for a time equal to 2.3 air exchanges and then releasing the remaining vapors even though product, sludge and/or a hazardous atmosphere remains in the tank.

Storage tank operators minimize the amount of vapors created by utilizing floating roof tanks. These types of tanks have a roof that floats on top of the liquid product. Unlike fixed roof tanks where the roof remains on the top of the structure (see Figure 1), the floating roof level correspondingly changes with the level of the liquid to prevent any space being created between the liquid level and the roof (see Figure 2). The roof can remain floating on the liquid from the total capacity of the tank all the way down to about six feet from the bottom of the tank for most

tanks and down to one foot for drain-dry breakout tanks. At that point the floating roof rests on its support legs and vapor space is created. When on the support legs, the vapor space is only about one tenth the volume of a fixed roof tank with the same capacity because the vapor space is about six feet while tank height is closer to sixty feet. A typical practice is to store more volatile liquids in floating roof tanks while heavy liquids to be stored for longer periods would more likely be sent to a fixed roof tank.

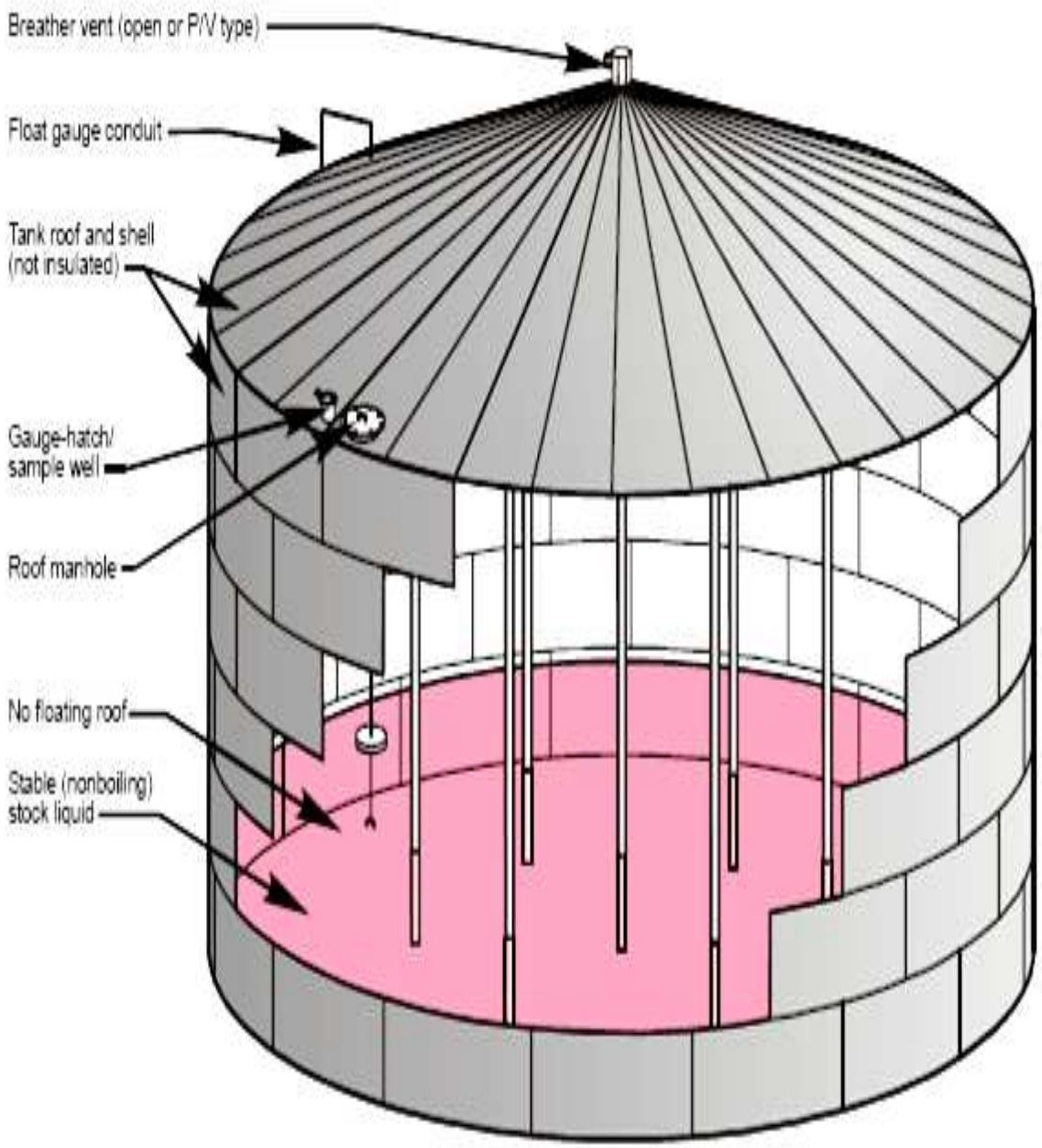

Figure 1 – Fixed Roof Tank (From AP-42, Section 7.1, U.S. EPA

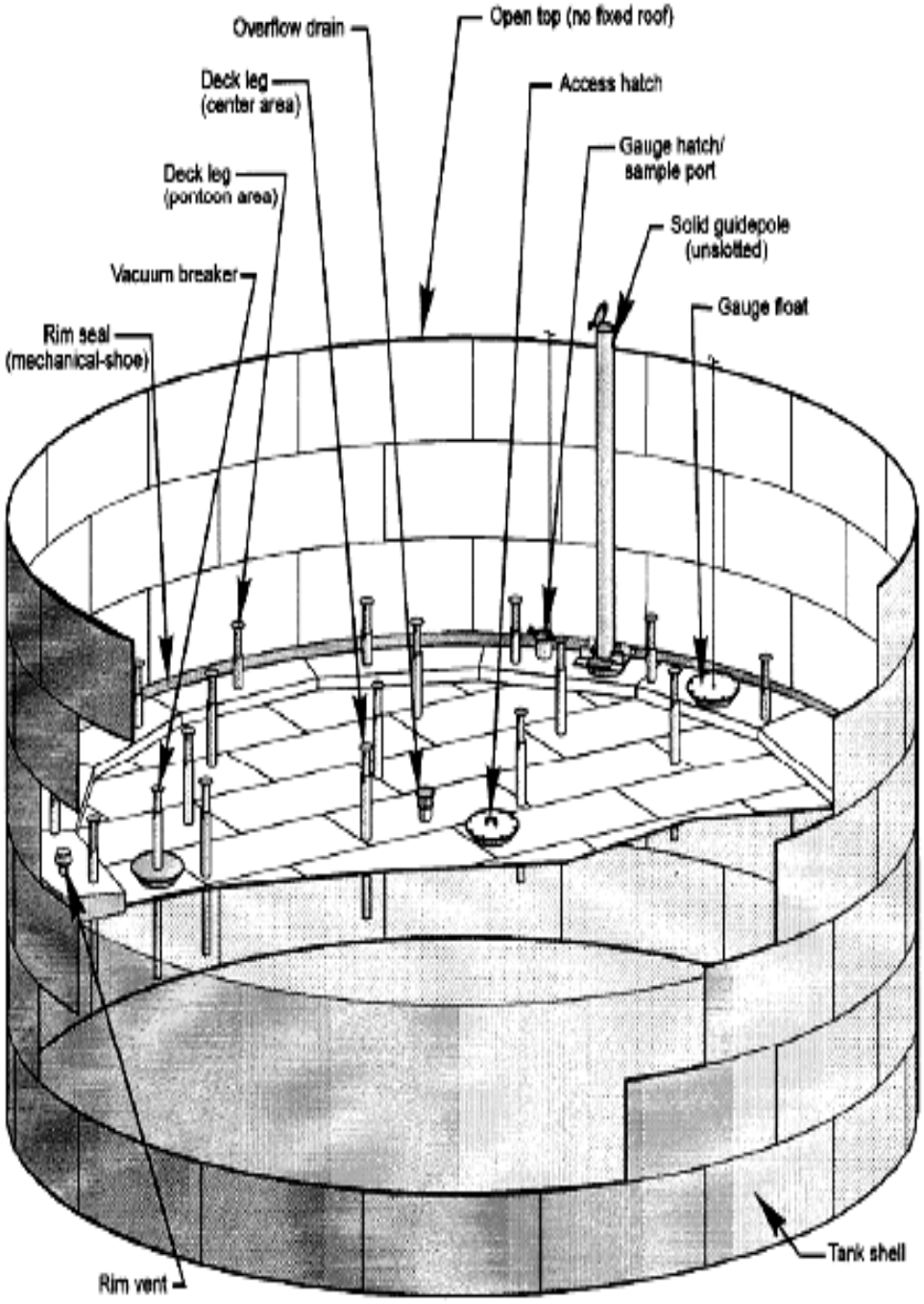

Figure 2 – Floating Roof Tank (From AP-42, Section 7.1, U.S. EPA)

Pipeline degassing is conducted in a similar manner to degassing a fixed roof tank with two noteworthy differences. First, the pipeline can be sealed at each end so as to minimize the vapor space opened to only the particular section being tested, maintained or replaced. These vapors can easily be captured and controlled under normal circumstances. Second, an inert gas, such as nitrogen, is often introduced at very high pressure to keep product and flammable vapors away from the work area. As the pipeline is refilled with product, the high pressure inert gas must be released. At the interface between inert gas and product there is some small amount of vapor mixing that potentially could emit a small amount of VOC. However, trying to control the small amount of VOC would require capture and control of a high pressure gas creating an unsafe condition.

PROPOSED AMENDMENTS

Staff proposes to amend Rule 1149 as follows:

- Remove time and equipment requirements in paragraphs (c)(5) and (c)(6) and replace them with a vapor concentration requirement of 5,000 ppmv, using EPA Reference Test Method 21 – Determination of Volatile Organic Compound Leaks, measured as methane. The concentration must be met for at least one hour after degassing has been completed. This will prevent tanks with excess product residual or sludge from being opened prematurely. The proposed vapor concentration standard conservatively translates to a ten percent LEL already met by many degassing operations. The vapor concentration standard will capture the majority of emissions created by product residual and sludge. Any technique, including liquid displacement, is allowed as long as any vapor displaced is routed to an approved vapor control or recovery system and the vapor concentration standard is met. In most instances, companies will utilize the same techniques currently in use but be required to do so for a longer period of time. However, new innovations and processes may be developed to meet the proposed standard. By establishing a standard as opposed to one or more control techniques, the rule provides flexibility to industry to apply technological advances.
- Extend the applicability of the rule to pipeline and to more above ground storage tanks (see Table 1). The proposed volume for gasoline storage tanks is to make the requirements for above ground and underground tanks consistent. The limit for crude oil storage tanks will capture most stationary tanks but not smaller portable tanks. Degassing storage tanks with low vapor pressure products was previously unregulated and the proposed rule will now require large tanks to control those emissions.

Table 1 – Proposed Changes to Storage Tank Applicability

Vapor Pressure	Typical Products	Current (gallons)	Proposed (gallons)
3.9 psia RVP	Gasoline	19,815	500
2.6 psia RVP	Crude	39,630	26,420
0.5 psia RVP	Kerosene	N/A	100,000

- Lower the VOC vapor concentration of a Vapor Leak from 10,000 ppmv to 5,000 ppmv. This will make the Vapor Leak standard consistent with the vapor concentration standard. It will require all the hoses, fittings and connections to meet the same standard the tank or

pipeline is required to meet. It differs from the requirements of "Vapor Tight" in Rule 463 (1,000 ppmv) and Rule 1178 (500 ppmv) because product and residual is being removed from the tank or pipeline instead of "stored" to which Rule 463 applies. The proposed amendment will also remove the test method from the definition and place it in the Test Methods section. The test method will include directions for distance and/or placement of the probe inlet. For storage tanks, the probe inlet shall be one foot above the bottom or sludge. Cylindrical tanks must be monitored at least two feet from the inner surface of the wall. Pipelines shall be monitored one foot or more from the pipeline. All monitoring measurements are to be recording and maintained to verify compliance with the vapor concentration standards.

- Require floating roofs that have landed on their legs or supports to be free of vapors, vented to a control device or, as an additional compliance option for drain-dry breakout tanks, be maintained in a vapor tight condition of 500 ppmv measured as methane. A compliance schedule is included for drain-dry breakout tanks that must be modified to meet the compliance option. Monitoring will be required monthly and records of monitoring results shall be maintained to verify compliance. While the roof rests on its support legs, the seals may lose effectiveness and fugitive emissions may occur. Roof landings may occur during product changes when crude oil is received from overseas and when products are sold from one company to another. This will address a common situation and codifies an enforcement policy. Definitions for "Drain-Dry Breakout Tank" and "Vapor Tight Condition" will be included.

- Require vacuum trucks that remove product residual and sludge from pipeline and storage tanks subject to the rule to exhaust vapors into a control device. Vacuum trucks are not designed to store vapors or control vapors themselves. When vacuum trucks pump product into their tanks, vapors are created from the liquid and sludge being agitated and may escape to atmosphere if not properly controlled.

- Limit the exhaust concentration of control devices used to 500 ppmv, measured as methane. In many cases the vapor concentration in a tank can be greater than 100,000 ppmv. Ninety percent control would allow 10,000 ppmv to escape and even 99 percent control would allow 1,000 ppmv to escape. This will set a stringent, yet achievable standard that is consistent with other AQMD rules.

- Require that product residual and sludge taken from pipeline and storage tanks subject to the rule are stored or disposed into closed containers or control systems free of liquid and vapor leaks. This will reduce emissions that might occur while the waste material is waiting further processing. Prior to the completion of degassing operations, all waste shall be disposed or stored in closed containers or control systems. An exception will be included for draining liquid from pipeline as long as the draining is continuous and the liquid is immediately transferred into a closed container. This will accommodate field repair of pipelines where draining into closed containers may lead to spillage and soil contamination. Once degassing has been completed per the proposed amendments, any remaining sludge should be mostly VOC free and can be transferred into storage bins or other appropriate waste containers. However, vacuum trucks used to collect liquid and/or sludge from tanks and pipelines subject to this rule must continue to limit their exhaust to 500 ppmv, measured as methane.

- Eliminate the emergency notification requirements and shorten the notification period and duration as well as eliminating the need for authorization. The notification procedure will be streamlined requiring between two hours and two days notification before

degassing takes place. It is common currently to have several duplicate notifications for a single degassing event due to scheduling issues. In addition, emergency degassing operations are delayed while waiting for the emergency to be approved by an authorized agency officer allowing uncontrolled VOC emissions into the atmosphere. Most emergency situations will take longer than two hours to get degassing equipment on-site. In the rare instance where an emergency occurs and degassing equipment is available in less than two hours, the facility may utilize Rule 430 – Breakdown Provisions. The new notification procedures will allow more flexibility to affected sources and improve the accuracy of the notifications.

- Delete the definition for Underground Storage Tank. The limits for underground were previously different and thus necessitated defining the difference between above ground and underground tanks. The limits are now the same and differentiation is no longer necessary.
- Add a definition for Natural Gas and exempt natural gas pipelines from the provisions of the rule. Natural gas is comprised mostly of methane which is not considered a VOC.
- Include a quantification protocol for voluntary greenhouse gas reductions. The provision in PAR 1149 is voluntary and limited to the control of methane emissions from the degassing of natural gas pipelines, which is currently exempt from the requirements of the rule. Efforts to limit methane emissions from natural gas pipeline repair and maintenance activities will allow companies to reduce Greenhouse gas emissions. The quantification protocol calculation methodology standardizes the quantification of the reductions but is general enough to allow innovative techniques as they are developed.
- Add a definition for Reid Vapor Pressure.
- Revise the definition of Volatile Organic Compound to refer to Rule 102 to be consistent with other VOC rules.
- Exempt small diameter pipelines and small lengths of pipeline depending on the vapor pressure of the liquid it previously contained. The pipeline exemptions are based on the exemptions for storage tanks with similar volumes. Thus a 500 gallon gasoline storage tank is roughly equivalent to a 100 foot length of pipeline containing gasoline. Similarly, 0.25 miles of crude pipeline is roughly equivalent to a 26,420 gallon crude oil storage tank.
- Remove the exemption for storage tanks exempted in Health and Safety Code Section 25281. Most of the tanks exempted under Health and Safety Code Section 25281 will not be subject to the amendments because they contain low vapor pressure products. However, gasoline tanks on farms with capacities greater than 500 gallons will now be subject to this rule. Gasoline tanks on farms with capacities greater than 1,100 gallons were already subject to the rule.
- Include an exemption from the requirements of the rule when tanks and pipelines are opened to connect or disconnect degassing equipment, sample emissions, purging inert gas from pipelines when reintroducing product or to connect or disconnect the pipeline including associated control techniques or control equipment. Based on technological and physical limitations and practical in situ repair operations, it has been AQMD policy not to check for vapor leaks when equipment or activities are being put in place that will minimize emissions as long as the work is continuous. In the case of pipelines, the only access will likely be the opening directly where the pipeline is disconnected. During the

process of opening the pipeline, the operation will be exempt. However, once the pipeline is open, measures must be taken to limit vapor emissions. Such measures may include, but are not limited to, blinding the pipeline, blocking with mud plugs or putting dry ice in the pipeline. Once the repair or maintenance activity is concluded, the vapor control measure may need to be removed to allow product flow. During the removal of the vapor control measure and subsequent reconnection of the pipeline, the rule will not apply.

EMISSION INVENTORY

The original emission inventory generated in 1987 estimated that uncontrolled emissions subject to Rule 1149 were 1.26 tons per day. Above ground storage tanks (AST) accounted for 0.5 tons per day while USTs accounted for the remainder. Based on the theoretical reduction from degassing over 2.3 air exchanges, the rule was expected to reduce emissions by 0.7 tons of VOC per day, with 0.4 tons of VOC per day being reduced from ASTs. The 1995 rule amendment made some new assumptions regarding how to calculate UST emissions but did not change the uncontrolled or expected reduction emission inventories.

However, over the 18 years since the initial emission inventory was generated, tank types, capacities and frequency of degassing incidents have changed. Initially, all tanks were assumed to be degassed once every ten years and estimates were made to calculate the volume required to be degassed. The initial emission inventory was based on floating roof tanks having 56,991 cubic feet to be degassed. The average fixed-roof tank degassed had a volume of 125,214 cubic feet to degas. Staff estimated that 101 tanks would be degassed each year (80 floating and 21 fixed). Assuming complete saturation of gasoline or crude oil, this accumulates to 0.5 tons of VOC per day.

Notification provisions in the rule have provided AQMD with detailed information including location, tank capacity and tank contents. Except in the relatively uncommon situation where a tank is degassed using liquid displacement, each time a tank is to be degassed by the facility or by a third party contractor, the degasser will notify the AQMD. With this information, staff has been able to refine the estimates of the volume, contents degassed and frequency of degassing events. Most importantly, the notification data shows that the ASTs are degassed at more than three times the frequency predicted. While most ASTs still are degassed every ten years or so for periodic repair and maintenance activities, some ASTs are degassed on a weekly basis because they are used primarily for product changes.

A limitation, however, is the lack of information regarding whether the AST was a floating roof or fixed roof type. This is important because for equal capacity tanks, the volume degassed in a floating roof tank is approximately one tenth that of a fixed roof tank. For example, a typical tank height is approximately 60 feet. It would be necessary to degas the entire 60 feet of a fixed roof tank while a floating roof tank would only need to degas about six feet of space. Staff conducted an assessment to determine the frequency of degassing when comparing floating versus fixed roof tanks. Industry was consulted, staff made site visits and compared notifications with tank rosters. It is estimated that 90 percent of all AST degassing operations are for floating roof tanks. Table 2 summarizes the notification data submitted to the AQMD between 2004 and 2006.

Table 2 – Notification Data Summary

Above Ground Storage Tanks	2004	2005	2006	3 yr ave.
# AST degassed	295	268	421	328
Ave capacity AST (cubic feet)	765,335	732,731	720,202	739,422
Total volume degassed (million cubic feet)	44.7	38.9	60.0	47.9
Total uncontrolled emissions (tpd)	1.7	1.4	3.1	2.1

The summary data shows that an average of 328 ASTs with an average capacity of 739,422 cubic feet were degassed annually. The volume was calculated by using the volume reported and assuming that only ten percent of the tanks were fixed and would degas the entire volume. For the remaining 90 percent of the ASTs, only about one-tenth of the volume reported would require degassing. This is because the roof of the floating roof tanks "floats" on the liquid in the tank until the tank liquid level is lower than the support legs which are generally about six feet tall.

Using the ideal gas law methodology, the uncontrolled average annual emission inventory estimate from ASTs would be 2.1 tons of VOC per day. The vapor pressure and molecular weight were determined from the product in the tank. The ideal gas law methodology assumes that complete saturation has had time to occur and that there are no additional sources of emissions. It is calculated as follows:

$$E = (VP / 14.7 \text{ psia}) * (MW / 379 \text{ ft}^3) * V$$

Where

E = emissions, lb
VP = vapor pressure, psia
14.7 psia is atmospheric pressure under standard conditions
MW = molecular weight, lb/lb-mole
379 ft^3 is the standard cubic feet per lb-mole at standard conditions
V = volume, cubic feet

However, the actual saturation rate depends on a variety of factors including temperature, agitation and time. For example, a completely filled fixed roof gasoline tank quickly drained would have a lower saturation rate compared to the same tank that was near empty when drained. Another factor complicating the ideal gas law methodology is sludge and product residue remaining in the tank when degassing commences. Additional hydrocarbon vapors are released from the sludge and residue while the tank is degassed.

In order to get a clearer picture of actual emissions being generated from tank degassing operations, 56 degassing logs were reviewed (see Appendix A). The logs indicate that there are fewer emissions in the storage tanks than the ideal gas law methodology would suggest. The actual emissions coming from tank degassing are 69 percent of the expected emissions using the ideal gas methodology. While most tanks have initial vapor concentrations greater than 100 percent LEL (roughly 50,000 ppmv, measured as methane), this is well below complete saturation. A possible explanation is that the tanks are drained faster than the liquid can evaporate. Once drained, degassing operations take place sooner than sludge and product residual can saturate the vapor space. Thus where the ideal gas law methodology would expect complete saturation, only partial saturation is seen. There may also be some unquantifiable loss when the contents of the tank are being pumped out of the tank. Vapor may be inadvertently removed if some part of the vacuum hose is above the liquid level.

Additionally, the degassing logs show that sludge and product residual significantly contribute to the emissions emanating from the storage tanks. A tank with partial saturation should be able to degas in a shorter time period than a completely saturated tank. However, the logs indicate that degassing actually takes a much longer time. On average, it takes two to three times longer because product residual and sludge continue to release vapors into the tank being degassed.

In the example provided in Table 3, a sample degassing log is examined. A floating roof gasoline tank with a vapor space of 7,921 cubic feet (59,249 gallons) is to be degassed. To comply with the current regulation, the company must degas at least 18,218 cubic feet of volume. The initial inlet concentration (150 percent LEL) is well below complete saturation used for an ideal gas calculation (approximately 600 percent LEL). After just over two hours, 2.3 air exchanges has been surpassed with an associated 149 pounds of VOC reduced. However, at least that much more remains in the tank and is not controlled until the inlet concentration is reduced below ten percent LEL. In the example tank, the emission reduction at 2.3 air exchanges is approximately 40 percent and the actual emissions are about 74 percent of the expected emissions.

Table 3 - Degassing Log Example

Gasoline Tank Example
Volume to be Degassed: 7921 cubic feet
Expected Emissions: 502 pounds of VOC

Time	Flow from tank (cfm)	Cumulative Volume (cubic feet)	Inlet Concentration (% LEL)	Hourly emissions (pounds)	Cumulative Emissions (pounds)
1345	100	0	150	0.0	0.0
1400	200	1500	125	5.7	5.7
1500	700	13500	100	37.7	43.3
1600	800	55500*	76	105.5	148.8
1700	1000	103500	48	91.6	240.5
1800	1000	163500	21	72.3	312.8
1900	2100	223500	9	31.6	344.5
2000	2100	349500	7	28.5	372.9

*2.3 Air Exchanges Surpassed

Expected	2.3 Air Exchanges	Actual
502.0	148.8	372.9

Closer examination of individual tank logs reveal a wide variation in the actual emissions degassed from the tank. Some tanks have emissions much lower than expected suggesting a tank relatively free of sludge and product residual that was full to begin with and drained quickly. Others have emissions greater than expected probably because there was a larger vapor space that had time to reach equilibrium and/or significant amounts of sludge and product residual that continued to evaporate while the tank was being degassed. Theoretically, 2.3 air exchanges should reduce emission by 90 percent but the logs indicate an actual reduction rate of only 37 percent.

Using the notification data information and comparing the ratios of expected versus actual and expected versus 2.3 air exchanges we can determine how many pounds of emission can be captured by adopting a vapor concentration standard and comparing it to amount of emissions captured by the current standard of 2.3 air exchanges (see Table 4).

Table 4 – Emission Inventory Comparison

	Uncontrolled	2.3 Air Turnovers	Remaining
Total emissions using ideal gas law (tpd)	2.1	1.9	0.2
Total emissions from degassing logs (tpd)	1.42	0.5	0.92

Comparing the two methods to calculate emission inventory shows that the there is a smaller overall inventory using emissions from degassing logs. However, more emissions reductions can be realized by further enhancements to the rule, particularly by the establishment of a vapor concentration standard.

In addition to the already regulated ASTs and USTs, the proposed rule amendment would lower the tank capacity and vapor pressures subject to the regulation. ASTs of capacities of 500 gallons or greater containing gasoline would be subject to the rule. The 100,000 liter (26,420 gallon) tanks or greater containing crude oil or other products with a Reid vapor pressure greater than 134 mm Hg (2.6 psi) and any tank larger than 378,500 liters (100,000 gallons) containing a product with a Reid vapor pressure greater than 5 mm Hg (0.1 psia) would be subject to Rule 1149.

Survey data and tank rosters provided by major refiners indicate that approximately 470 new tanks would be subject to the rule. The average capacity of the newly applicable tanks reported by the refiners is 2.5 million gallons. The average of the newly applicable tanks at terminals and other locations is 2.2 million gallons. The overall average for newly applicable tanks is 2.3 million gallons. The proposed amendments will regulate an additional 50 percent of VOC containing tank volume in the AQMD resulting in commensurate reduction of VOCs emitted to the atmosphere.

Using the actual tank capacities and product contents from those refiners who provided the survey data, the average uncontrolled degassing emission from a newly applicable tank is 2,370 pounds of VOC. Applying the same correction factor of actual versus expected emissions (0.685) seen from the degassing logs summarized in Table 3, there would be 1,620 pounds of uncontrolled emission from degassing each newly applicable tank. Conservatively assuming that the tanks are degassed once every ten years, the annual uncontrolled emissions from newly applicable tanks would be 76,140 pounds (0.1 tons per day).

Aside from storage tanks, pipelines containing organic liquids, primarily crude oil and gasoline, would also be subject to PAR 1149. According to the California Office of the State Fire Marshall, there are 7,500 miles (approximately 4,000 miles in the South Coast Air Basin) of hazardous liquid transportation pipeline within the state. California laws mandate that each pipeline system be tested at least every five years. Testing usually consists of hydrotesting or use of internal inspection tools sometimes known as “smart pigs”. Most pipeline inspection and repair activities already vent vapors to an uncontrolled vacuum truck. The result is 4.2 million cubic feet annually of gasoline or crude oil vapor could be released to the atmosphere. The proposed amended rule would apply to pipelines outside of permitted facilities that were six

inches or greater in diameter. Pipelines shorter than 100 feet in length are exempt as are pipelines shorter than 0.25 miles containing or previously containing VOC liquids having a Reid vapor pressure less than 202 mm Hg. Staff estimates the addition of pipelines to PAR 1149 adds 0.4 tons of uncontrolled VOC per day to the emission inventory.

In the 1987 version of the rule underground storage tanks (USTs) originally contributed 0.63 tons per day to the uncontrolled emission inventory and the rule was expected to reduce 0.3 tons of VOC per day. In 1995, the staff report indicated that the number of USTs had decreased by 70 percent. However, emission calculations in the 1995 Final Staff Report for Proposed Amended Rule 1149 – Storage Tank Degassing show that the emission reductions remained the same because emissions from USTs were higher than originally estimated and industry practices now reduced emissions by 99 percent. Over the past three years, an average of 501 USTs were degassed with an average capacity of 11,346 gallons. The uncontrolled emissions from USTs were 0.07 tons per day calculated by adjusting the number of tanks and average volume in comparison to estimates made in previous staff reports. Using the 99 percent control efficiency claimed by the 1995 rule amendment, the emission reduction from USTs were also 0.07 tons of VOC per day. No emission reductions from USTs are claimed in this proposed amendment. In summary, the total uncontrolled emissions from all sources subject to the proposed amendments to Rule 1149 is 1.97 tons of VOC per day with 0.57 tons of VOC per day controlled by existing regulations (see Table 5). Therefore the remaining emission inventory to be further regulated by the proposed amendments to Rule 1149 is 1.42 tons per day of VOC.

Table 5 – Emission Inventory from All Rule 1149 Sources

Source	Emissions Inventory Before Control	Emissions Controlled by Existing Rule 1149	Remaining Emissions Inventory
ASTs currently subject to rule (tpd)	1.42	0.5	0.92
USTs (tpd)	0.07	0.07	0
Newly applicable ASTs (tpd)	0.1	0	0.1
Pipelines (tpd)	0.4	0	0.4
Total emissions from all Rule 1149 Sources (tpd)	**1.97**	**0.57**	**1.42**

EMISSION REDUCTIONS

The proposed rule amendment would set a vapor concentration limit of 5,000 ppmv on tanks and pipelines subject to the rule. Connections, hoses, and vacuum trucks would also be required to keep emissions below 5,000 ppmv. Control devices would not be required by the regulation. Alternative methods such as routing the exhaust to other tanks, applying chemicals or water to reduce vapors or any other means to reduce the tank or pipeline concentration would be allowed so long as hydrocarbon vapors with a concentration greater than 5,000 ppmv were not allowed to be vented to atmosphere. Control devices used to reduce the vapors in tanks and pipelines would be limited to an exhaust concentration of 500 ppmv, which is consistent with other AQMD rules.

A limit of 5,000 ppmv captures an estimated 90 percent or more of the remaining emissions. Utilizing the degassing logs, a comparison can be made between the quantity of emission captured when the 5,000 ppmv standard is reached and the total quantity of emissions in the

storage tank. Reviewing the example in Table 3, almost 97 percent of emissions are captured when degassing to 5,000 ppmv (roughly ten percent LEL). Reviewing all of the storage tanks that met or exceeded the standard, a limit of 5,000 ppmv captures between 86.3 percent and 99.7 percent of emissions from tanks. The average emission reduction is 95.8 percent.

Adoption of a vapor concentration standard of 5,000 ppmv will reduce emissions from existing and newly applicable sources by at least 90 percent. The total annual uncontrolled VOC emissions from existing and newly applicable sources are 1.99 tons per day. The current provisions in the rule already reduce 0.57 tons per day of the uncontrolled VOC emissions. The proposed rule amendments will reduce VOC emissions by another 1.27 tons per day calculated based on the practice of degassing to 5,000 ppmv (see Table 6). If the tanks were near complete saturation, another 0.7 tons per day of emission reductions would be realized. Further controlling vacuum trucks used to remove residual product and sludge, requiring residual product and sludge to held in closed containers that are free of liquid and vapor leaks and establishing a vapor concentration requirement for control devices will limit fugitive emission losses.

Table 6 – Emission Reductions from All Rule 1149 Sources

Source	Emission Inventory	Emissions Controlled by Existing Rule 1149	Remaining Emissions Inventory	Emissions Controlled by Proposed Rule
ASTs currently subject to rule (tpd)	1.42	0.5	0.92	0.82
USTs (tpd)	0.07	0.07	0	0
Newly applicable ASTs (tpd)	0.1	0	0.1	0.09
Pipelines (tpd)	0.4	0	0.4	0.36
Total emissions from all Rule 1149 sources (tpd)	**1.99**	**0.57**	**1.42**	**1.27**

Along with reductions in VOC emissions from the proposed provisions of this rule, there would also be some increases in criteria pollutants because of increased use of control equipment. Except where liquid balancing is used, the primary methods of control are absorption onto carbon or oxidation using internal combustion engines and thermal oxidizers. Conservatively, it is assumed that all new sources will be controlled using either an internal combustion engine or thermal oxidizer. Undoubtedly, some sources will use liquid balancing and other technologies or degassing methods may be developed which do not require combustion.

Over the past three years, 47.9 million cubic feet of tank space was degassed on average annually. Based on this average and the calculated average cubic feet degassed per gallon of propane, 35,143 gallons of propane are used to degas storage tanks each year. PAR 1149 would increase the usage of propane by nearly seven times for tanks already subject to the rule. Additionally, another 7.0 million cubic feet of degassing would be necessary with the proposed pipeline and smaller/low vapor pressure tank requirements. The total average amount of degassing would increase to 54.9 million cubic feet annually. The total propane from degassing operations would increase to 277,273 gallons annually. Another 26,700 gallons of propane would be required to control vapors from storage tank roof landings. The overall total propane increase would be 303,973 gallons annually.

AQMD default emission factors were used for criteria pollutants emitted by thermal oxidizers and internal combustion engines except for NOx, VOC and CO from internal combustion engines. NOx, VOC and CO emission factors for internal combustion engines were taken from a source test conducted on an internal combustion engine fired with propane controlling vapors from a tank degassing operation. Like other internal combustion engines used for this purpose, it is equipped with a catalytic converter. U.S. Department of Energy, Energy Information Administration factors were used to determine carbon dioxide (CO2) emission factors. The ratio of thermal oxidizer use (69 percent) to internal combustion engine use (31 percent) was determined from notification data. The average daily increase in criteria pollutants and greenhouse gas emissions are calculated below:

Table 7 – Related Increase in Criteria Pollutants and Greenhouse Gas Emissions

Current	NOx (annual lbs)	VOC (annual lbs)	SOx (annual lbs)	CO (annual lbs)	CO2 (annual lbs)	Methane (annual lbs)	PM (annual lbs)
at 100% thermal oxidizer use	450	9	162	112	445,227	10	10
at 100% IC engine use	1,230	64	12	738	445,227	0	176
at 69%/31% T.O./ICE use	690	26	116	305	445,227	7	61

Proposed	NOx (annual lbs)	VOC (annual lbs)	SOx (annual lbs)	CO (annual lbs)	CO2 (annual lbs)	Methane (annual lbs)	PM (annual lbs)
at 100% thermal oxidizer use	3,891	65	1,145	797	3,155,748	70	70
at 100% IC engine use	8,719	516	88	5,231	3,155,748	0	1,245
at 69%/31% T.O./ICE use	4,891	204	820	2,162	3,155,748	48	432

	NOx	**VOC**	**SOx**	**CO**	**CO2**	**Methane**	**PM**
Average daily increase (pounds)	12	1	2	5	7,426	0	1

For CEQA purposes, a peak emissions scenario was developed based on the busiest day over the past four years of notification data. On that day, two large gasoline and three large crude oil ASTs were degassed. One newly applicable large heavy product tank and two newly applicable lengths of pipeline were added. Using the same criteria emission factors in the average daily increase, the peak emissions, not including the associated increase in truck fuel usage are as follows:

	NOx	**VOC**	**SOx**	**CO**	**CO2**	**Methane**	**PM**
Peak daily increase (pounds)	17	1	3	9	11,178	0	2

COST AND COST-EFFECTIVENESS

Currently, nearly all USTs and some ASTs are already degassed to meet the 5,000 ppmv limit. For those operations that currently meet only the 2.3 air exchange standard, it is calculated that it will take 2.8 times longer to degas a tank to the proposed limit (see Appendix B).

For already applicable ASTs, degassing companies generally charge between $2,000 and $20,000 to degas tanks. For an average sized tank, a typical cost would be between $7,000 and $10,000 with $2,000 of that amount a flat fee and the remainder based on an hourly rate. On average, a typical storage tank takes about eight hours to degas to the current rule requirement of

2.3 air exchanges. To reach the proposed concentration limit, it is estimated that it will take 24.1 hours. This hourly increase of 180 percent would add $14,680 per operation. Historically, 328 ASTs are degassed annually; therefore the cost increase would be $4.8 million dollars.

On average, up to 192 already applicable storage tanks per year would require additional controls to limit vapors being exhausted by vacuum trucks while removing sludge from the tanks. At an estimated cost of $2,000 per operation, an additional $0.4 million dollars would be necessary to control vapors exhausted by vacuum trucks during sludge cleaning. Sludge cleaning occurs does not occur during all storage tank degassing operations. It is only necessary during repair and maintenance of the storage tank, not during product changes.

At a few facilities, annualized capital expenditures totaling $37,000 for vapor pumps, system automation, pressure relief valves and other equipment will be necessary to meet the vapor control requirements during roof landings. In addition, those facilities would have a total annual cost of $80,100 for supplemental fuel. The total annualized cost increase for controlling tank landings would be $117,000.

Already applicable ASTs

Currently: $2,000 + 8.5 hours * $941/hr = $10,000

Proposed: $2,000 + 24.1 hours * $941/hr = $24,680 (a $14,680 increase)

Annual Cost Increase: $14,680/operation * 328 degassing operations = $4.8 million

Vacuum Truck Control: $2,000/operation * 192 sludge cleaning operations = $0.4 million

Annualized Increase for Tank Roof Landing Control: $117,000

Total Annual Cost Increase = $4.8 million + $0.4 million + $117,000 = $5.3 million

For the 470 newly applicable ASTs and again assuming that they are degassed once every ten years, 47 newly applicable tanks would be degassed. However, because the newly applicable tanks are 58 percent smaller, based on survey data and tank rosters, and have 51 percent lower vapor concentration, because of the lower vapor pressure products previously contained within, they could be degassed at 30 percent of the cost or $8,700. At a cost of $8,700 each, the 47 newly applicable tanks degassed annually would do so at an annual cost of $0.4 million dollars. To control vapors exhausted by vacuum trucks during sludge cleaning, again at an estimated cost of $2,000 per operation, an additional $0.1 million dollars would be expended.

Newly applicable ASTs

Newly applicable AST = 24.1 hours * 0.58 volume * 0.51 vapor concentration = 7.1 hours

Proposed: $2,000 + 7.1 hours * $941/hr = $8,700

Annual Cost Increase: $8,700/operation * 47 operations = $0.4 million

Vacuum Truck Control: $2,000/operation * 47 sludge cleaning operations = $0.1 million

Total Annual Cost Increase = $0.4 million + $0.1 million = $0.5 million

Requiring vacuum trucks to vent vapors to a control device such as a carbon canister during pipeline degassing would increase the cost by $500 to $4,000 per operation according to contractors who offer those services. An ordinary operation may potentially displace between

one mile and 30 miles of pipeline depending on the distance between shut off valves. Eight hundred miles of pipeline need to be maintained and tested annually. At an average of five miles, 160 pipeline degassing operations would be necessary annually. At $2,000 per operation, the total annual cost increase to control pipeline degassing would be $0.3 million dollars.

Newly applicable pipelines

Annual Cost Increase: $2,000/operation * 160 operations = $0.3 million

For USTs, degassing companies charge between $600 and $1,000 to degas a tank. Because virtually all are already meeting the proposed limit, they would not need to change their operations or charge more to their customers.

As proposed, the rule would reduce emissions by between 1.27 and 1.97 tons per day with an estimated cost of $6.1 million dollars. The overall cost per ton of VOC reduced by the proposed amendment would be $13,159 (see Table 8).

Table 8 - Cost Effectiveness Summary

Emission Source	Emissions before control	Emissions controlled by existing regulations	Emissions controlled by proposed rule	Annual Estimated Cost (millions)
ASTs currently subject to Rule 1149 (tpd)	1.42	0.5	0.82	$5.3
USTs (tpd)	0.07	0.07	0	$0
Newly applicable ASTs (tpd)	0.1	0	0.09	$0.5
Pipeline (tpd)	0.4	0	0.36	$0.3
Total emissions from all Rule 1149 Sources (tpd)	1.97	0.57	1.27	$6.1

Cost Effectiveness

Total annual cost / total annual emissions = $6.1 million / (1.27 tpd * 365 days) = $13,159 per ton of VOC reduced.

INCREMENTAL COST-EFFECTIVENESS AND ANALYSES OF ALTERNATIVE CONTROL MEASURES

Under Health and Safety Code Section 40920.6, the AQMD is required to perform an incremental cost analysis when adopting a Best Available Retrofit Control Technology (BARCT) rule or feasible measure required by the California Clean Air Act. To perform this analysis, the AQMD must (1) identify one or more control options achieving the emission reduction objectives for the proposed rule, (2) determine the cost effectiveness for each option, and (3) calculate the incremental cost effectiveness for each option. To determine incremental costs, the AQMD must "calculate the difference in the dollar costs divided by the difference in the emission reduction potentials between each progressively more stringent potential control option as compared to the next less expensive control option."

Proposed Amended Rule 1149 implements Control Measure Fug-04 from the 2007 Air Quality Management Plan. Because Control Measure Fug-04 is intended to meet feasible measure requirements under the California Clean Air Act, an incremental cost analysis is required.

Several alternative options were evaluated including one less stringent standard and two more stringent standards. The first alternative examined was to increase the number of air exchanges required from 2.3 as is currently required in the rule, to 4.6 air exchanges. Theoretically this would raise the control efficiency of the rule from 90 percent to 99 percent. However, as discussed above, 2.3 air exchanges only achieves 37 percent control efficiency. From review of the degassing logs, it is estimated that emission reductions would increase to approximately 55 percent control efficiency. This would be well below the 90 percent control efficiency expected by the current proposal and reduce only 0.8 tons per day of VOC emissions. While the overall cost would be lower ($4.6 million), the cost effectiveness would rise to $15,753 per ton of VOC reduced.

A small number of the degassing logs reviewed indicate that those tanks were degassed well below the proposed limit. From those logs, we can estimate that decreasing the proposed limit from 5,000 ppmv to 3,500 ppmv would increase the average cost of the operation by 202 percent and lowering the limit even further to 2,000 ppmv would increase the average cost by 221 percent resulting in an incremental cost effectiveness of $273,973 and $684,932 per additional ton of VOC reduced, respectively. The large increase in incremental cost is due primarily to the very small additional emission reductions realized from lowering the proposed vapor concentration limit.

Table 9 – Cost Effectiveness by Vapor Concentration Limit

PPM limit	Emission reductions (tons per day)	Average Additional Hours Per Tank	Annual Additional Cost (million)	Incremental Cost Effectiveness (Cost/Additional Ton
5,000	1.27	15.6	$6.1	$8,524
3,500	1.276	17.5	$6.6	$273,973
2,000	1.278	19.2	$7.1	$684,932
4.6 air exchanges	0.8	13.0	$4.6	N/A

VOLUNTARY GREENHOUSE GAS REDUCTION QUANTIFICATION PROTOCOL

There is an increasing need to provide a valid, regional credit mechanism for global warming gases in the South Coast Air Basin. The AQMD Governing Board has proposed creation of a voluntary carbon-reduction credit program, to be called the SoCal Climate Solutions Exchange. This program, to be developed in the near future in a separate rule making activity, will incentivize cost-effective emission controls. The applicability, use, recordkeeping, issuance and all other aspects of the carbon-reduction credit will be addressed when the SoCal Climate Solutions Exchange program is developed.

The purpose of Rule 1149 is to reduce VOC emissions from storage tank and pipeline degassing operations. Methane, a VOC exempt compound, is present in natural gas pipelines. The proposed amended rule will include a quantification protocol for companies who voluntarily

control methane emissions from natural gas pipelines. While methane is not a VOC, it is a global warming gas with a global warming potential more than 21 times that of CO2.

Methane losses from natural gas pipelines mainly occur during maintenance and repairs. Because of the vital nature of this utility, maintenance and repairs must be accomplished as rapidly as possible. When a situation arises requiring the pipelines to be opened to atmosphere, the pipeline is closed at nearby locations on either side of the opening. The gas in the pipelines is allowed to blowdown or be purged from the pipeline. The repair or maintenance work is completed and the pipeline is reopened allowing the natural gas to flow once again.

The most straightforward technique to minimize methane emissions is to minimize the length of pipeline that will be opened to atmosphere. Automated valves located several miles apart would be closed to isolate the area. Then manual valves located closer to the source could be closed to minimize the amount of blowdown gas that would otherwise be released. Other reductions might be possible from bleeding off the gas to a storage container or control device. If a combustion process is utilized, the carbon reduction would be reduced by four percent to reflect the subsequent release of CO2 created from burning the methane. Any supplemental fuel required for combustion is also subtracted from carbon reductions as it too is combusted into CO2. It is intended that the non-prescriptive calculation provided in PAR 1149 will provide an incentive to develop innovative techniques to minimize methane emissions. The global warming potential (GWP) for methane is taken from the International Panel on Climate Change (IPCC) Second Assessment Report. In the report, the IPCC established a GWP (100 years) for methane of 21 carbon dioxide equivalent units.

COMMENTS AND RESPONSES

Comment 1
The rule should consider recovering the VOC vapors to be used as fuel instead of burning low concentration vapors which wastes money and time and creates so much CO2.

Response
Staff agrees with the comment and has purposely designed the rule requirements to allow non-destructive control techniques, including liquid displacement and refrigerated condensation. Establishing a vapor concentration, as opposed to prescribing control techniques, provides flexibility to industry to apply technological advances and opt to recover vapors instead of combusting vapors if they deem it cost-effective.

Comment 2
The engine and thermal oxidizer (TO) criteria pollutant emission factors appear to be incorrect based on experience and past source test data. I have submitted source test data showing lower emission factors. Additionally, considering that voluntary emission reduction of greenhouse gases will become an issue sometime in the future, I think it is important to note pound for pound destroyed, a TO may emit as much as two to three times the amount of pollutant than the engine doing the exact same work. This is because the internal combustion engine uses the vapor as the primary fuel source while the thermal oxidizer must use a supplementary fuel to oxidize the extracted VOC.

Response
Staff has reviewed available source test data and adjusted the NOx and CO emission factors for internal combustion engines. The previous emission factors did not consider engines with catalytic converters which are now standard in the industry. The emission factors for CO2 were not altered to reflect differences in fuel usage. There is insufficient data available to try to quantify the amount of fuel increase attributable to internal combustion engines as compared to thermal oxidizers. However, supplemental fuel use will be included when determining the amount CO2 created when determining greenhouse gas emission reductions under subdivision (e) of PAR 1149.

Comment 3
The requirements of paragraph (c)(2) appear to mean that the vapor space of a storage tank should be vented to a control device once the roof lands even if the liquid in the tank has not completely been drained out of the tank. Please clarify.

Response
The requirement to control the vapor from storage tanks with the roof landed applies only after emptying is complete. Emptying consists of removing the bulk of the liquid but not necessarily the removal of residual product or sludge. Storage tanks that contain liquid, including filling and draining operations, are subject to the requirements of Rule 463 and Rule 1178. Rule 463 requires the process of emptying or refilling to be continuous once the roof is resting on its legs or leg supports. The proposed language will be clarified accordingly.

Comment 4
We do not believe that PAR 1149 is a good candidate for inclusion in the proposed CO2 trading program, and particularly not as the very first rule. However, if Rule 1149 were ultimately included in the trading program, that should happen only after the trading program has been fully defined. Without that knowledge about the trading program, stakeholders cannot effectively comment on the appropriateness of including this rule.

Response
The recently announced SoCal Climate Solutions Exchange initiative will provide a valid, regional credit mechanism for global warming gases in the South Coast Air Basin. That program will be developed as a separate regulation. PAR 1149 will include a quantification protocol for companies who voluntarily control methane emissions from natural gas pipelines to quantify carbon reductions. Natural gas pipelines will be exempt from the requirements of Rule 1149 because methane is not a VOC. However it is a global warming gas with a global warming potential more than 21 times that of CO2 and provides an opportunity to voluntarily reduce greenhouse gas emissions.

Comment 5
The AQMD suggests that the proposed 5,000 ppmv VOC concentration, which represents various criteria (e.g., definition of a vapor leak, degassing completion criterion, etc.), is approximately equal to a 10 percent LEL for gasoline. This seems like an appropriate level – it is consistent with the established criteria for confined-space entry, etc. We note, however, that compliance with the requirements of the rule would be made somewhat simpler if a combustible gas detector (i.e., an "LEL meter") could be used as an alternative to a "Method 21" instrument.

Response
While it is understood that many degassing operations currently use LEL meters for safety purposes, the limitations of the meter makes it unsuitable for enforcement purposes. The LEL meter must be set to the particular vapor the operator believes he is working with (i.e. hexane) and does not accurately detect the presence of other VOC containing chemicals. Petroleum products are blends of chemicals and the LEL meter may underreport the true vapor concentration in some cases, whereas an instrument that meets Method 21 requirements will not.

Comment 6
The description of the test methods in paragraph (d)(1) has been revised to include distance specifications for where to place the probe of an instrument when measuring VOC concentrations in tanks that are undergoing cleaning/degassing. (We understand that these distance specifications are the same as those specified in a Ventura APCD rule, and that the Ventura rule has a VOC criterion of 10,000 ppmv.) We believe that setting distance specifications is appropriate. However, because the specifications were added to the draft rule only recently, we have not had the opportunity to fully evaluate and discuss the implications of these specifications with the District.

We would respectfully request an opportunity to more fully evaluate these proposed distance specifications together with staff. We believe that the final staff report should include an analysis that addresses, 1) the potential additional time required to degas a tank based on sampling at the proposed specific locations inside the tank, 2) the potential additional degassing time anticipated due to the District's 5000 ppmv criterion compared to the 10,000 ppmv in the Ventura rule, and 3) the overall feasibility of achieving the AQMD's proposed criteria.

Response
The distance specifications are the same as the Ventura APCD rule and commonly used field procedures by tank degassing operators in the AQMD. It is not uncommon for tanks degassed for maintenance purposes to already meet the 5,000 ppmv criterion based on monitoring practices that are similar to the ones proposed. The analysis to compare the additional time required to degas from the current standard is included in Appendix B and is more appropriate than comparing it to Ventura's rule. The increased time PAR 1149 stated in Appendix B is included in the cost-effectiveness calculations of the rule and demonstrates the feasibility of the proposed criteria.

Comment 7
Compliance with the prohibition of vapor leaks for closed containers used to store sludge may warrant its own distance specification for the purpose of precluding placement of a monitoring probe at, or even underneath, the cover of the container.

Response
The distance specification for determination of vapor leaks from closed containers remains unchanged from the existing rule and has been in practice for many years. The distance of the probe shall be one centimeter or less from the source. That would allow the probe to be placed at the cover, but not underneath the cover of the container.

Comment 8
While there likely are VOC emissions associated with many pipeline repair activities, pipeline inspection activities typically do not result in any emissions. The process of hydrotesting a

pipeline involves flushing the entire line with water thereby displacing product and/or vapor to a facility at the far end of the line. No venting takes place. Also, because the pipeline is filled with water for testing, the pipeline is no longer subject to the Rule as the "product" in the line is now water. With regard to the use of internal inspection tools (e.g., "smart pigs"), these tools are loaded into special closed "traps" and then pushed through the pipeline by the product being shipped. This internal inspection process also does not vent any vapors.

Response
The activities involving pipelines, including maintenance, repair and testing, were previously completely unregulated in terms of air pollution. The proposed requirements will establish vapor concentration limits for pipelines when they need to be opened to atmosphere. Control techniques such as water displacement, traps that limit vapor released during inspection and blinding the pipeline with inert gas or plugs are all commonly practiced acceptable methods to limit vapors. The proposed requirements will require that some method of limiting vapor release be practiced.

Comment 9
PAR 1149 includes streamlined notification procedures; WSPA appreciates and supports these revised requirements. We can reasonably expect that, for cleaning or degassing procedures involving tanks, the proposed revised notification requirements are not likely to be a problem. However, emergencies involving pipelines could be a different matter. We envision unplanned circumstances involving, for example, an urgent need for the services of a vacuum truck – but we know that not all vacuum trucks are equipped with VOC controls (e.g., carbon canisters). We submit that some provision for emergencies involving pipelines is warranted.

Response
The emergency scenario described above is best handled through the Rule 430 – Breakdown Provisions. Allowing the use of equipment to vent vapors without control (and likely without proper notification) would essentially circumvent the intent of Rule 1149. Establishing the guidelines for reporting an emergency, the necessary documentation to validate the emergency and the administrative relief the emergency situation would provide would necessitate recreating the provisions of Rule 430 within the framework of Rule 1149.

Comment 10
Applicability, subdivision (a) – last sentence. This sentence is potentially confusing and can be misinterpreted as "pipeline outside the boundaries of a facility", "pipeline outside of a stationary tank", etc. We suggest that it should be re-structured to read:

> "This rule applies to the cleaning and degassing of: 1) pipeline opened to the atmosphere outside the boundaries of a facility; 2) stationary tank; 3) reservoir; or 4) other container..."

Response
If interpreted as suggested in the comment, the rule would only apply to pipelines outside of facilities, pipelines outside of tanks, etc. and not to the tanks, reservoirs or other containers themselves. Since that is clearly not the intent of a Storage Tank and Pipeline Cleaning and Degassing regulation, it is not necessary to restructure the applicability.

Comment 11
Please consider adding a basic definition of a "pipeline". This would be appropriate since pipelines are newly regulated as a specific source category under this rule.

Response
There would be no additional information provided by including a definition in the rule for "pipeline" that would be identical to the dictionary definition of the word.

Comment 12
Although "liquid balancing" might not be the appropriate term, the practice of flushing a pipeline with low vapor pressure organic material, or with water, is common. Thus, some recognition of this practice in the definitions might be worthwhile.

Response
Recognizing the various techniques available for complying with the proposed provisions of requirement paragraph (c)(3) is not necessary because paragraph (c)(3) references a vapor standard that shall be met and does not prescribe a method to achieve that standard. Specifying specific control techniques may have the inadvertent effect of stifling innovation by limiting the techniques only to those listed.

Comment 13
It is not clear that the requirements under paragraph (c)(1) are intended to be applicable to stationary sources. WSPA suggests retaining the word "stationary" (i.e., do not delete the entire phrase, "Above-ground *stationary* tank.."). Otherwise, the section could be misconstrued as potentially requiring degassing of tanker trucks or other portable tanks.

Response
The word "stationary" will be retained.

Comment 14
Please see Table 1, paragraphs (c)(2), and (e)(2). PAR 1149 expresses vapor pressure criteria as Reid Vapor Pressure (RVP). However, Rules 463 and 1178 use True Vapor Pressure (TVP) – see Rule 463 (c), and Rule 1178 (b), respectively. The use of two different measurement "standards" in different rules applicable to tanks is potentially confusing. WSPA suggests that PAR 1149 also use TVP.

Response
Per discussion with the commenter, the request has been withdrawn and the original references to RVP will be retained.

Comment 15
One of the criteria for applicability of the rule to tanks or pipelines is that they contain or "previously contained" organic material having a certain vapor pressure. We understand that it is the AQMD's intent that this reference is to the material that was "last present" in the tank or pipeline before degassing – and not any material historically present. Please clarify the language accordingly.

Response
Pipelines and tanks last containing products subject to the rule must meet the requirements of PAR 1149. Products that were removed from tanks or pipelines and subsequently replaced with liquids not subject to the rule would not be subject to the provisions of PAR 1149. The term "previously contained" will be replaced with "last contained".

Comment 16
Is it the AQMD's intent to require that vacuum trucks used for cleaning/degassing activities be equipped with exhaust controls up until the point where the criteria in paragraphs (c)(1) or (c)(4) (for tanks and pipelines, respectively) are achieved? We suggest that the language similar to the provision in paragraphs (c)(9) be added to paragraph (c)(6). Also, one common practice is to route the exhaust from the vacuum truck exhaust back into a storage tank. Because the vacuum truck is not exhausting vapors to the atmosphere, we believe that the requirements of paragraph (c)(5) would be met.

Response
Vacuum trucks used to remove liquid, sludge or vapors from tanks or pipelines subject to this rule must limit their exhaust emissions below 500 ppmv or control emissions in some other manner. Venting their exhaust vapors to a control device or into a storage tank including the tank being degassed would be acceptable means of controlling the vapors. However, the process of vacuuming VOC containing liquids and sludge can create additional fugitive vapors. Therefore, staff is proposing to require all operations subject to the rule utilizing a vacuum truck, including tank and pipeline draining, residual cleaning and sludge cleaning, to vent the exhaust to a control device or meet the 500 ppmv vapor concentration limit. Vendors offering control equipment for vacuum truck exhaust have said that they have sufficient inventory to meet industry's needs. There are also alternative techniques available, including submersible, diaphragm and positive displacement pumps that can be used to minimize vacuum truck exhaust fugitive emissions.

Comment 17
WSPA appreciates the AQMD's efforts to streamline the notification process. However, we believe that the proposed written follow-up notice and fee payment, required by the next business day, would be exceptionally burdensome – particularly for those who conduct frequent product changes. Therefore, we suggest that the follow-up reports and fees be submitted on a monthly basis. We believe that, in addition to being less burdensome for the AQMD as well, the cost of check processing and handling will be reduced for both the payer and the AQMD.

Response
Current AQMD policy for other regulations requiring notification, including Rules 203, 1166 and 1403 allow up to three working days after the event has taken place for follow up submittals. The proposed follow-up notification requirements in PAR 1149 will reflect that same policy and allow up to three working days.

Comment 18
This section requires a continuous organic vapor analyzer on the outlet of carbon adsorption systems used for degassing. We note that, although this language is in the current rule, the requirement only applies to equipment used for degassing. The proposed requirement could be interpreted to apply to carbon canisters on vacuum trucks. Because we do not believe that this is the AQMD's intent, we request that the requirement be clarified accordingly.

Response
The rule will be clarified to limit the applicability of the continuous organic vapor analyzer to carbon adsorption systems used for degassing.

Comment 19
The provision of paragraph (c)(8), as written, can be interpreted to require that liquids or sludge removed from a tank or pipeline must be stored. However, because there can be alternate dispositions for liquids or sludge (e.g., draining to a closed industrial sewer system), we suggest that that this requirement be clarified to apply to those situations if/when liquid or sludge is stored. In addition, a reference to paragraph (c)(3) needs to be added for the benefit of pipelines.

Response
PAR 1149 will be clarified to include a reference to paragraph (c)(3). Additionally, it will allow disposal into closed systems such as closed industrial sewer systems or sumps, as well as storage containers to allow for immediate treatment and control of VOC emissions.

Comment 20
Requiring drain-dry breakout tanks to evacuate the vapor space each time it lands would create safety problems, provide little air quality benefit, greatly increase Greenhouse gas emissions and potentially lead to disruptions of fuel delivery throughout the system. The tanks in question are designed to have support legs no higher than one foot and a bottom sloped to a sump such that no product or sludge remains on the tank walls or bottom after emptying. Vapor sampling indicates that the tanks are maintained in a vapor tight condition even while the roof has landed.

Response
Allowing tanks to land floating roofs without restriction would lead to excessive fugitive emission losses. There are very high concentrations of vapor in a relatively large vapor space that may be lost to atmosphere if precautions are not taken. Most facilities vent such emissions to a control device. However, for tanks with minimal vapor space designed to drain-dry, maintaining the tank in a vapor tight condition and venting vapors displaced during refilling would adequately control emissions. Such tanks shall be monitored on a monthly basis to verify that they remain in vapor tight condition.

PAR 1149 has been revised to control floating roof landings when 1) The vapors are vented to a control device; or 2) The tank has been emptied of liquid and gas-freed (Gas-freed means that the vapor concentration within the tank is less than 5,000 ppmv, measured as methane). Additionally, in lieu of meeting the above requirements, drain-dry breakout tanks may maintain a vapor tight condition outside the tank shell. Vapor tight means that the vapor concentration outside the shell of the tank is less than 500 ppmv, measured as methane.

Comment 21
The 2.3 volume air exchanges requirement should be maintained in PAR 1149 specifically for non-pipeline drain-dry tanks. The drain-dry tanks have minimal product residual and controlling the vapors for 2.3 air exchanges should be sufficient to control vapors to 5,000 ppmv. Requiring a measurement would compel the terminal to access the tank and result in more emissions to the atmosphere than would the use of the 2.3 air exchanges.

Response
The 2.3 volume air exchange requirement is a calculation that would reduce the vapor concentration by 90 percent. If the vapor space in the tank is near complete saturation, the vapor concentration may be higher than 300,000 ppm. Reduction by 90 percent would leave over 30,000 ppm remaining in the tank. This would be substantially higher than the proposed limit. While requiring a measurement would lead to some negligible amount of fugitive emissions, the value of being able to verify compliance justifies the negligible loss.

Comment 22
PAR 1149 appears to require notification whenever the roof lands. With numerous landings each day, we would be required to make several notification reports per day and pay hundreds of thousands of dollars of notification fees each year. This is an unreasonable financial and reporting burden.

Response
The notification requirements in PAR 1149 apply only to when a tank or pipeline is cleaned and degassed meaning that the liquid is emptied from the tank or pipeline and the vapor is removed until the tank or pipeline is considered gas-freed. Tank roof landings where the tank is not made gas-free do not require notification. In those situations, the tanks are vented to a permitted control device with specific permit conditions for control, monitoring and recordkeeping. Regardless, vapors still must be controlled when refilling the tank per the requirements of Rule 463.

Comment 23
Paragraph (c)(5) regulating VOC emissions from vacuum trucks used in pipeline and tank degassing operations has a more restrictive requirement of 500 ppmv which is normally a limit for control equipment. In paragraph (c)(4), the vapor leak limit for equipment is 5,000 ppmv. For consistency, we suggest the use of the 5,000 ppmv limit for vacuum truck exhaust as it is not considered a control equipment.

Response
Vacuum trucks in the AQMD have been used both as equipment and as "control devices" when outfitted with carbon canisters. When used as equipment venting to a permitted control device, a vacuum truck would only need to meet the vapor leak requirement of 5,000 ppmv, measured as methane. However, if the VOC concentration of the vapors is 5,000 ppmv or greater, they are considered a regulated material and those vapors must be controlled to less than 500 ppmv VOC. Therefore, the vacuum truck must meet the more stringent limit of 500 ppmv, measured as methane, which is consistent with the requirements that all other AQMD VOC control devices must meet.

Comment 24
The requirement for monitoring using an approved instrument "measured as methane" basically says use a Foxboro TVA 1000 FID as no other instrument meets the requirements. We have approval letters from AQMD for use of PID which are calibrated and measured as methane. The language should be limited to say, "EPA Method 21 Instrument".

Response
The requirement for monitoring using EPA Method 21, measured as methane, comes directly from the language of the existing rule. Vapor leaks have required this procedure prior to this

amendment and the vapor concentration standards apply to vapor leaks to the tanks and pipelines as well. EPA Method 21 does not specify any particular type of monitoring equipment. Staff is aware of other devices that can measure vapor concentration using EPA Method 21, measured as methane. Permit conditions that require other types of measurements such as vapor concentration measured as hexane or benzene concentration limits will also need to be fulfilled in order to demonstrate compliance with those particular permit conditions.

Comment 25

There is nothing that specifies when to commence degassing. I suggest specifying a time period when degassing should commence.

Response

Once a tank has been emptied, it is subject to Rule 1149. At that time, the tank must be free of vapor leaks and may not be opened to atmosphere until the vapor concentration within the tank has been shown to 5,000 ppmv or less, measured as methane. If the tank has a floating roof, then immediately after the roof has landed and the tank is drained empty, the vapors must be controlled per the requirements of paragraph (c)(2).

Comment 26

There is nothing that specifies that you can use a degassing unit to "refloat" the roof after cleaning and degassing. I suggest eliminating the words "during a product change".

Response

The phrase "during a product change" has been removed and now refers more generally to all tank roof landings. However, refilling operations are subject to the requirement of Rule 463 and are not subject to the requirements of Rule 1149.

Comment 27

I suggest you eliminate the monitoring requirements contained in paragraph (c)(8). The requirement to have a monitor "installed and operated" at the exit might suggest that it is permanent. This is just not practical, feasible or reasonable. I strongly urge that the abatement device monitoring requirements be left to the permit conditions.

Response

The language contained in paragraph (c)(7) has not changed from previous versions of the regulation. The rule will be clarified to limit the applicability of the continuous organic vapor analyzer to carbon adsorption systems used for degassing. Carbon adsorption units used for degassing operations will have to continue meeting the requirements of the rule and any additional conditions established by the permit to operate.

COMPARATIVE ANALYSIS

Health and Safety Code Section 40727.2 requires a written analysis comparing the proposed amended rule with existing AQMD and federal regulations. Federal regulations do not require control of vapors from degassing operations but 40 CFR Part 280 does require underground storage tanks to be empty before removal. No other AQMD regulations apply to storage tank or pipeline degassing.

SOCIOECONOMIC ASSESSMENT

A socioeconomic analysis of the amendments to Rule 1149 will be performed. This analysis will be released no later than 30 days prior to the AQMD Governing Board hearing.

CALIFORNIA ENVIRONMENTAL QUALITY ACT (CEQA)

Pursuant to the California Environmental Quality Act (CEQA) and AQMD Rule 110, appropriate documentation will be prepared to analyze any potential adverse environmental impacts associated with the proposed amendments to Rule 1149. Comments received at the public workshop and CEQA scoping meeting will be considered when preparing the CEQA document.

DRAFT FINDINGS UNDER THE CALIFORNIA HEALTH AND SAFETY CODE

Health and Safety Code Section 40727 requires that prior to adopting, amending or repealing a rule or regulation, the AQMD Governing Board shall make findings of necessity, authority, clarity, consistency, non-duplication, and reference based on relevant information presented at the hearing. The draft findings are as follows:

Necessity – State and federal health-based ambient air quality standards for ozone are regularly exceeded in the AQMD. The reduction of VOC from the proposed amendments to Rule 1149 is part of a comprehensive strategy necessary to meet federal and State air quality standards.

Authority - The AQMD Governing Board obtains its authority to adopt, amend, or repeal rules and regulations from Health and Safety Code Sections 39002, 40000, 40001, 40440, 40441, 40702, 41508, and 41700.

Clarity - The AQMD Governing Board has determined that the proposed amendments to Rule 1149 – Storage Tank and Pipeline Cleaning and Degassing, are written and displayed so that the meaning can be easily understood by persons directly affected by them.

Consistency - The AQMD Governing Board has determined that Proposed Amended Rule 1149 – Storage Tank and Pipeline Cleaning and Degassing, is in harmony with, and not in conflict with or contradictory to, existing statutes, court decisions, federal or state regulations.

Non-Duplication - The AQMD Governing Board has determined that the proposed amendments to Rule 1149 – Storage Tank and Pipeline Cleaning and Degassing, do not impose the same requirement as any existing state or federal regulation, and the proposed amendments are necessary and proper to execute the powers and duties granted to, and imposed upon, the AQMD.

Reference - In adopting this regulation, the AQMD Governing Board references the following statutes which the AQMD hereby implements, interprets or makes specific: California Health and Safety Code sections 40001, 40440, and 40702.

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Appendix A – Tank Degassing Logs

In Appendix A, the volume refers to amount of cubic feet in the tank needed to be degassed. The expected emissions are calculated from the ideal gas law methodology for the volume and product contained in the tank. The actual emissions are taken from the tank degassing logs and reflect the total pounds of VOC controlled before the operation was stopped. The actual emissions when 2.3 Q was reached is the amount of pounds of VOC controlled when the current Rule 1149 requirement of 2.3 air exchanges was met. Emissions from the degassing logs are calculated by determining the vapor concentration going into the control device and then determining the hourly pounds of emission controlled as the flow and vapor concentration change over time. In addition to other information, the degassing logs note the air flow from the tank, the vapor concentration from the tank, the air flow going into the control device and the time.

Vapor concentration to the control device is calculated by multiplying the inlet vapor concentration from tank to ratio of the air flow from the tank over the overall air flow into the control device.

$E = (C * M * F * T) / (V * 1{,}000{,}000)$

where:

E = emissions, lb
C = concentration of vapor going into the control device, ppmv
M = molecular weight of vapor, lb/lb-mole
F = air flow to control device, cfm
T = time, minutes
V = molar volume

and $C = I * (A / F)$

where:

C = concentration of vapor going into the control device, ppmv
I = concentration of vapor from the storage tank, ppmv
A = air flow from the storage tank, cfm
F = air flow to control device, cfm

Tank	Capacity (cubic feet)	Expected emissions from ideal gas law (lb)	Actual emissions reduced from degassing logs (lb)	Actual emissions reduced from degassing logs when 2.3 Q reached (lb)	Product	Actual vs. Expected	2.3 Q vs. Expected
1	106,029	6,729	1,988	824	Gasoline	29.54%	12.25%
2	22,620	402	1,476	280	Sour Naphtha	367.16%	69.65%
3	44,872	2,848	253	102	Gasoline	8.90%	3.59%
4	21,154	376	2,670	224	Sour Naphtha	710.11%	59.57%
5	83,095	2,983	95	81	Sour Water	3.18%	2.72%
6	11,133	706	279	100	Gasoline	39.52%	14.16%
7	7,921	502	346	177	Gasoline	68.93%	35.28%

8	40,212	2,552	5,322	1,856	Isomerate	208.54%	72.73%
9	15,708	997	404	266	Isomerate	40.48%	26.67%
10	83,095	5274	197	184	Gasoline	3.74%	3.49%
11	76,027	4790	1,521	1,163	Gasoline	31.75%	24.27%
12	157,284	9909	2,209	1,654	Gasoline	22.29%	16.69%
13	114,512	7214	4,309	2,850	Gasoline	59.73%	39.51%
14	56,143	3537	11,592	1,760	Gasoline	327.72%	49.77%
15	90,478	5700	525	266	Gasoline	9.21%	4.66%
16	95,108	5992	2,691	2,662	Gasoline	44.92%	44.43%
17	16,964	609	1,720	100	Gasoline	282.45%	16.45%
18	75,218	4739	5,775	466	Gasoline	121.86%	9.84%
19	28,066	774	731	189	Gasoline	94.44%	24.40%
20	1,257	80	100	64	Transmix	125.45%	79.65%
21	15,708	997	14	14	Sour Naphtha	1.38%	1.38%
22	6,597	733	17	15	Brine Water	2.28%	2.10%
23	153,726	5518	1,627	588	Alkylate	29.49%	10.66%
24	50,894	840	247	172	Ethanol	29.43%	20.48%
25	11,133	183	220	145	Ethanol	120.08%	79.21%
26	80,000	2,872	1,690	1,266	Crude Oil	58.84%	44.08%
27	55,000	1,974	462	Not reported	Crude Oil	23.40%	21.06%
28	40,000	1,436	952	Not reported	Crude Oil	66.30%	59.67%
29	76,440	5,104	2,969	499	Gasoline	58.17%	9.77%
30	21,434	2,384	6,177	1,007	Gasoline	259.10%	42.24%
31	73,054	6,153	4,376	3,630	Gasoline	71.12%	59.00%
32	49,055	4,162	10,416	1,849	Gasoline	250.26%	44.43%
33	45,454	2,885	950	844	Gasoline	32.93%	29.25%
34	50,802	3224	821	736	Gasoline	25.46%	22.83%
35	113,636	7,212	1,361	1,361	Gasoline	18.88%	18.88%
36	13,369	848	1,598	289	Gasoline	188.44%	34.12%
37	50,802	3,224	234	234	Gasoline	7.25%	7.25%
38	40,107	254	34	34	Naphtha	13.44%	13.44%
39	46,791	766	114	114	Alkylate	14.91%	14.91%
40	46,791	766	209	186	Alkylate	27.34%	24.32%
41	46,791	766	490	239	Alkylate	64.03%	31.23%
42	46,791	766	220	198	Alkylate	28.66%	25.86%
43	16,956	1,076	245	125	Gasoline	22.75%	11.62%
44	11,775	747	191	79	Gasoline	25.59%	10.61%
45	105,975	6,726	1,242	927	Gasoline	18.46%	13.78%
46	105,975	6,726	2,472	881	Gasoline	36.75%	13.10%
47	11,775	747	206	193	Gasoline	27.52%	25.87%
48	21,143	60	99	99	Ethanol	164.79%	164.79%
49	13,734	871	203	174	Gasoline	23.33%	19.98%
50	11,775	77	40	40	Ethanol	51.91%	51.91%
51	40,107	144	66	57	Transmix	46.00%	39.47%
52	16,956	608	19	13	Transmix	3.12%	2.21%
53	65,582	4162.4	10,417	1,849	Gasoline	250.26%	44.42%
54	97,667	6199	4,376	3,630	Gasoline	70.60%	58.56%
55	28,656	1028	6,177	1,007	Crude Oil	600.88%	97.97%
56	113,636	7,212	1,815	1,742	Gasoline	25.17%	24.15%
Total	2,942,983	156,163	106,969	39,506	all (total)	68.50%	25.30%

Appendix B – Time to Complete Degassing

The information in Appendix B was evaluated to determine the increase in time required to meet the proposed vapor concentration limit of 5,000 ppmv. Various degassing contractors submitted degassing logs for tanks they had degassed over the previous year. The tanks listed met the criteria that they both were degassed until the current rule requirement of 2.3 air exchanges was met and degassed until the proposed rule requirement of 5,000 ppmv (ten percent LEL) was met.

Not all tanks met the dual criteria and those that did not were not included. The average times to reach 2.3 air exchange and the proposed concentration limit were calculated and are used to determine how much longer, on average, it will take to degas tanks to the new standard. This information is used to calculate both increased costs and increased secondary emissions created from associated control equipment such as internal combustion engines and thermal oxidizers.

Tank	Time to Reach 2.3 Air Exchanges (hours)	Time to Reach Proposed Concentration Limit (hours)
A2	3	11
A3	6	22
A4	3	20
A5	2	3
A6	2	7
A7	1	4
A8	6	34
B1	4	7
B2	3	4
B3	7.5	12.5
B4	10	17
B6	8	18
B8	7	7
B9	13	23
B10	2	8
B11	4	23
B12	2	16
B14	1	4
B15	1	1
B16	4	9.5
B17	1	2
B19	5	11
B20	1	3
B22	11	40
C1	45	57
C2	13	74
C3	20	127
D1	8	5
D2	3.5	5
D3	6	4.5
Total (hrs)	203	579.5
Average (hrs)	8.5	24.1